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ABSTRACT

This paper discusses current developments in neuroscience and cognitive psychology that have significance for education and learning, and considers the effects of violent and emotion-laden media messages. Topics include: (1) the developing brain, including the roles of genetics, experience, metaphorical imagination, and culture; (2) the links among emotion, cognition, and body; (3) brain plasticity and the effect of culture; (4) the importance of a healthy school culture; (5) learning as a biological process; (6) the genetic cycle of learning; (7) the importance of serotonin for learning and memory; (8) the importance of time in learning; (9) the importance of homeostasis; (10) endorphins and addiction to media messages, including desensitization; (11) the importance of context and a healthy school culture; (12) a role for school and classroom management; and (13) a role for education and legislation. Together, education and legislation must work to foster maximum potential for the media and their messages, and, at the same time, minimize their adverse affects on the individual and society. (Contains 39 references.) (MES)

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Endorphins and Media Messages:
Addicting Students to Mediated Violence and Emotion

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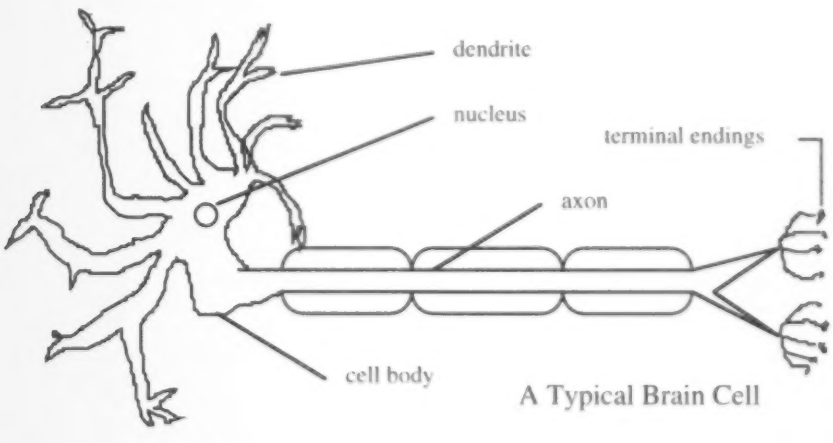
The one organ in the human body that educators deal with most in their work is the human brain. However, as an association of professionals, educators generally know very little about the brain and how it works. Developing some fundamental understandings about how the brain holistically constructs a mentality and a propensity for action provides educators with more tools and approaches for meeting the individual needs of every student. Gaining understanding about the human brain provides educators with some clues to assist them in their work as mentors and curriculum associates in the learning process.

It is understandable that educators would have so little knowledge of the brain. The human brain is the most complicated organ in the body and knowledge about the brain and how it works is advancing rapidly. However, it is important for educators to keep up with recent studies in the area of neuroscience and cognitive psychology. Current thinking has great significance for education and learning, and new developments continue to challenge the wisdom of current educational practices.

The Developing Brain

Every individual is endowed, at birth, with the full complement of brain cells (neurons) s/he will enjoy for the rest of his/her life. The maximum number and configuration of brain cells is normally "fixed" at the moment of conception. No one can generate new brain cells after birth. However, the number of functional brain cells will vary from person to person, i.e., we are not all given the same number of brain cells and this is a result of environmental and genetic circumstances. A "normal" human brain is endowed with approximately one hundred billion functional brain cells (Kandel, Schwartz & Jessell, 1991).



A Typical Brain Cell

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"The role of a neuron is to receive information from outside and to transmit through its three fundamental parts: the cell body, the dendrites, and the axon." (Levinthal, 1988, p.54) It is

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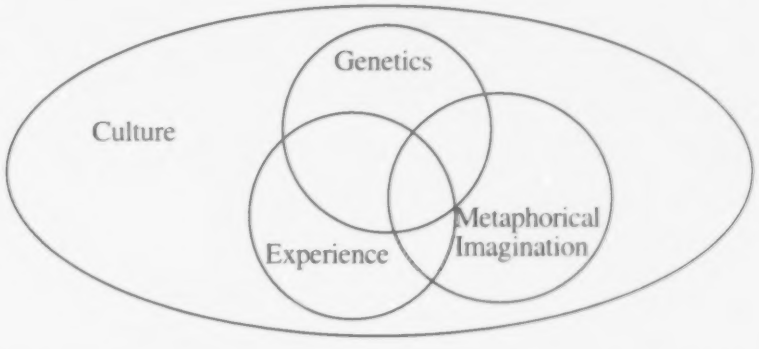
the job of the cell body and dendrites to take in information from other nerve cells. It is the job of the axon to pass that information on to other brain cells.

In a normal brain, neurons are specialized and systematically organized in ways that allow individuals to, at once, process complex tasks of perception, thought and action (Damasio, 1994; Holloway, 1992). Neurons are not haphazardly arranged. The neurons organize into interconnected systems or neurological pathways by three important "architects" and "construction workers" who "build" the brain. These three architects and builders are: **genetics** (the coding of biological information on DNA), **experience** (any physical and/or perceived interaction between an individual and the environment), and **metaphorical imagination** (the linking of new thoughts and feelings to the known). These three, (genetics, experience, and metaphorical imagination) work collaboratively to construct a *mentality* and a *propensity for action* that is historically founded in **culture**.



Within an individual's culture, these three architects and construction workers act in concert, in a holistic and life-long interplay of neurological and biochemical cause and effect relationships.

However, each architect/construction worker has a primary role to play in building a brain's intellectual, physical and emotional capabilities. The primary role for ***genetics*** is to develop and maintain the neuronal systems (integrated neurophysiology) and concomitant biochemistry. The primary role for ***experience*** is to prune functional brain cells that are of little use to the individual and identify functional brain cells that are of most use to the individual. The primary role for ***metaphorical imagination*** is to nurture the functional brain cells that are of most use to the individual and help them to make new connections with other functional brain cells, thereby setting up new neural pathways. In concert, within their own role and specialized function, all three architect/construction workers are responsible for the release and synthesis of biochemicals in the brain. The primary role of ***culture*** is to provide the context within which all three architect/construction workers can build. To carry through on the metaphor of "building a brain," the primary role and function of **culture** is that of the zoning commission. **Culture** determines what will be built and what will not be built by comparing the potential a brain has for development and the environmental circumstances surrounding the individual brain. **Culture** helps to maintain and encode the history and ideology of an individual's ancestors in the brain.

By discussing a newborn child's capacity for language acquisition we can examine the primary roles of the three architect/construction workers and the importance of **culture** as a provider of context. First,***Genetics*** endows all "normal" newborn children with the ability to acquire and socially use all the languages of the world, complete with the appropriate phonemic intonations. By the first year of life, unless children have been exposed to language and phonemes outside their own culture, children are able to operate best within their own culturally specific language framework. Second, this is because of ***culturally*** **specific** ***experience***, where every normal child is deprived of alternative language acquisition strategies, due to neurological

pruning. While investigating phonemic recognition, McAuliffe (1985) found that babies from birth to six months can recognize every sound imaginable. Yet, after six months babies lose the ability to recognize sounds that are not used in their immediate environment. It is thought that the neurological connections responsible for recognition of little used phonemes were irretrievably destroyed by the enzyme calpain. Third, after the age of one, children can still approximate language acquisition through ***metaphorical imagination***, which nurtures the connections between functional brain cells and makes new neural pathways for phonemic recognition and voice synthesis. "When a neuron in the brain dies (and about 10,000 of them apparently do each day), there may be some 'sprouting' of axon terminals of adjacent neurons, but there is always a net loss." (Levinthal, 1988, p.55) Fourth, this all occurs within **culture**, an assimilated **culture**, that determines the extent to which language will be acquired and used.

For example, Asian students learning English as a second language often have difficulty pronouncing the "r" sound. **Culture** determines early in life that many individuals born in Japan are not be exposed to the phoneme "r." As a result, the other three architects and construction workers building the brain make it physically difficult, if not immediately impossible, to pronounce the English word, "rice." On a more personal note, as a native-born Oregonian, I lived for fourteen years in Australia and never acquired a "proper" Australian accent. The neurons for phonemic recognition and voice synthesis were just not present in the brain, and because of **culture**, the brain simply does not miss what is not there. I didn't even notice that I had a "speech impediment" until I was made aware of this neurological condition by one of "me best mates" when I was about to leave Australia. A couple of hours before I was to board the plane to return to the U.S., Barry informed me that for the last fourteen years I had been mispronouncing his name. He said I always pronounce his name "Berry," which is something you eat, instead of "Barry," which is his name. Needless to say, I was embarrassed and tried to reconcile my mistake by pronouncing his name correctly, with the proper Australian intonation. Yet, try as best I could, I was unable to produce the proper bleating "a" sound that is followed quickly by a soft "r" sound. I can remember experiencing incredible frustration as I repeatedly tried to pronounce his name "properly." After working with me for quite some time, we finally compromised. We decided that from that time on I would refer to him verbally as "Bazza," which is the Aussie nickname for "Barry." It appears that I had no trouble at all finding the bleating "a" sound when it was followed by a buzzing "z" sound. The neuronal connections seemed to be in tact for that language task.

So, the bad news is we're ***genetically*** given a limited number of brain cells at birth and those neurons are systematically "weeded out" by ***experience***. But, the good news is, the remaining functional brain cells are **not** "hard wired," and every individual's ***genetics***, ***experience*** and ***metaphorical imaginings*** work to help neurons change shape and form new connections between other functioning brain cells. As a result of this ongoing activity, every individual's ***genetics***, ***experience***, and ***metaphorical imaginings*** are constantly engaged in planning and redesigning the brain's shape and biochemistry, **within the context of culture**.

Historically, educational practices have evolved around metaphors of the brain as a vessel to be filled with knowledge, or as a sponge that mops up information, and more recently, as a computer. However, the human brain exhibits a plasticity that confounds such metaphors of thinking about the brain. Today, we know the shape, and biochemical makeup of the brain, is **physically changed** by ***experience***, and ***metaphorical imagination***. We know that such physical change is fueled by a ***genetically*** determined capacity for memory and perception. As a result, this knowledge invites new and more powerful metaphors for describing and thinking about the brain and teaching and learning. The brain is "plastic," and it is "wet," with balanced states of biochemical activity.

Educators who adopt metaphors of the brain that embrace notions of neural plasticity and a need for biochemical balance, can find hope in the belief that every student has the ability to construct a mentality and a propensity for action that falls within the realm of social and cultural

acceptability. These will be our student-centered educators. These educators use their knowledge of the brain to mentor students with a hope for realigning and nurturing neural pathways and biochemical activities and guide students toward prosocial thoughts and actions. These are the educators who will use time and educational strategies to make a difference in the lives of students.

It is nearly incomprehensible to think that a typical neuron may have as many as one thousand connections with other neurons and that a normal brain typically has 100 billion neurons. When considering all the biochemical messengers in the brain as well as the number of possible connections, this equates the approximate number of possible different connections in a normal individual to be near infinite (Levinthal, 1988). The implications of this potential for brain development and teaching and learning are awesome and should provide all educators with great hope for every individual. We need never give up hope.

Emotion, Cognition, and Body are Inextricably Linked

Still another common misconception among educators is the idea that the brain is only about thinking or cognition; and that pure thought or rationality has little to do with the psycho-motor or the affective domains. In his book, *Descartes' Error*, Antonio R. Damasio (1994) provides thought provoking arguments and empirical reasoning to support the human brain as a center for a holistic interplay between the cognitive, affective and psycho-motor domains. He provides compelling support for the idea that we construct a mentality and that mentality is based on all that the brain and body do. Ostensibly, he suggests that emotion, thought, and the physical body are all intrinsically linked, one affecting the other in a cascade of biochemical and neurological activity.

Damasio has found evidence supporting the existence of a somatic marker system or acquired "gut feeling" in normal individuals, that is based on emotion and body awareness, and is essential for successful social living and prosocial decision-making. He proposes that somatic markers or "gut feelings" are acquired emotional overtones that mediate our rational thought processes. "Somatic markers are thus acquired by experience, under the control of an internal preference system and under the influence of an external set of circumstances that include not only entities and events with which the individual must interact, but also social conventions and ethical rules." (Damasio, p. 179) Damasio points out that some people do not have the ability to learn or pay attention to a somatic marker system. He indicates that these are the exceptions and they are not "normal." For example, trauma patients with damage to the left anterior frontal lobe of the brain have lost the ability to establish somatic markers as a result of experience. As well, he points out that psychopaths and sociopaths do not seem to experience the full range of feelings of guilt or remorse for their antisocial actions. People such as these, who are not "normal," tend to live their lives as a disaster. These people make poor life decisions with disastrous effects on themselves and the world around them.

Somatic markers or "gut feelings" are linked to various events in our lives, whether real or imagined, and they are metaphorically transferred to new situations. In this way, they assist cognitive processing by providing an emotional overtone when attending to the perceived consequences of a planned action. For example, we can experience negative gut feelings when contemplating decisions and actions that run a risk to our own health and safety. For example, running in a crowded hallway may not be the best way to move from A to B, or going skydiving without proper instruction is probably not the best choice for recreational activity. As well, we can experience positive gut feelings that are based on notions of delayed gratification. For example, doing "hard work" in math class or cleaning up our bedroom. These positive gut feelings based on delayed gratification, may be linked to perceived payment of future dividends for "good" behavior, or they may be linked to altruism. This article will argue that it is in the best interests of the student and the rest of society that schools and educators should emphasize altruism, rather than material rewards, as a basis for social decision-making.

Somatic markers or "gut feelings" are also linked to "Sign Stimulus." A sign stimulus is a visual, kinesthetic, and/or auditory signal that activates a predetermined mental and emotional state in the individual. Every individual perceives a sign stimulus differently and the same sign stimulus may activate different "gut feelings" in different individuals (Damasio, 1994) For example, the words "pop quiz" may signal a "gut feeling" of heightened anxiety for the ill prepared student and a "gut feeling" of jubilation for the well-prepared student. Often a "stereotypical response" is the first proposition considered by an individual when a sign stimulus activates a somatic marker. A "stereotypical response" is characterized by a consist pattern of behavior that occurs in virtually the same order and fashion every time. For example, an ill prepared student, upon hearing the words "pop quiz" from the teacher, may experience an unpleasant "gut feeling" and tacitly activate a series of idiosyncratic avoidance behaviors. A colleague of mine tells a story about her seventh grade biology teacher who used to ask questions of the class and then call on students whether they raised their hands or not. If the student didn't know the answer, the teacher would have some demeaning comment that embarrassed the student. Accidentally, my colleague discovered that if she were in the act of blowing her nose the teacher would never call on her. So, she developed a somatic marker and a stereotypical response to alleviate the situation. Whenever her biology teacher began asking questions (her sign stimulus) a negative gut feeling came over her (her somatic marker) and she immediately reached for her box of tissues and blew her nose (her stereotypical response). The teacher never called on her.

Brain Plasticity and the Effect of Culture

The brain's capacity and capability for perception and memory are the keys to cognitive processing. Our students, literally, physically construct a personal "reality" by dynamically building biochemical connections between neurons. Students' experiences and metaphorical imaginings generate new dendritic spines and axon terminals (nerve endings) which reach out and make new neuronal connections.

> ...synaptic change [or brain plasticity] is a sum of moment-to-moment changes laid successively upon each other. In this way each new moment of experience adds to, or subtracts from, whatever has just preceded. At any particular moment, the pattern of synaptic change provides a running average of what has occurred previously. (Squire, 1987, p. 240)

This neuronal adaptation is a "dynamic" process where experience and metaphorical imagination generate new neuron connections, which proposes and invites behavior and interaction with the environment, that when acted upon results in new experience and metaphorical imagination, that forms new neuron connections. It continues in a "genetic" cycle of behavior/experience/metaphorical imagination/genetic coding/behavior/... (Bachevalier, 1990; Edelman, 1987; Ornstein & Thompson, 1984).

A student's brain is always physically adapting to new input and redefining behavior thought appropriate for a situation, which is reflected in the student's ever-changing ideas, beliefs, attitudes, and values. Educators need to realize and understand that students always act in ways they think are in their best interests. Students simply do the best they can with what they are given. Normally, students physically construct neuronal circuits with balanced states of biochemical and neuro-electrical activity and these become their conceptual maps of social reality and cultural ways of knowing; these are their schemata.

Schemata are constructed as a result of socialization inside culture. If we broadly define culture as the sum of ways of living built up by a group of human beings, which is transmitted from one generation to another, it is relatively safe to say that very little is learned outside culture. Hence, the culture we learn within is important. From the day we are conceived, the quality of the culture we are born into will do much to help determine our future freedoms and liberty. Remember the example cited earlier indicating how a child born into a culture, rich in a wide range of phonemes, was better able to enhance and strengthen neurological connections associated with

properly acquiring and using the language of the culture. Well, it is also possible, that from an early age, a sense of others and attitudes concomitant with prosocial activity can be transmitted via a caring culture and that these modal values can be embedded in an individual as somatic markers.

> The automated somatic-marker device of most of us lucky enough to have been reared in a relatively healthy culture has been accommodated by education to the standards of rationality of that culture. In spite of its roots in biological regulation, the device has been tuned to cultural prescriptions designed to ensure survival in a particular society. If we assume that the brain is normal and the culture in which it develops is healthy, the device has been made rational relative to social conventions and ethics. (Damasio, 1994, p.200)

The need for a healthy culture is very important in the early years of life, and because of our capability for neural plasticity, a healthy culture is important throughout a lifetime.

The Importance of a Healthy School Culture

There is a need to create a healthy school culture, that is based on principles of civility, and that supports learning by teaching and endorsing socially acceptable thoughts, emotions, and behaviors. A healthy school culture will develop in normal students automated somatic markers that define socially acceptable behavior. A healthy school culture cannot be based on rewards and punishment; it must operate at the principled level of moral development. It must consider the cognitive, affective, and psycho-motor domains as holistically integrated and equally important. Only when the school's culture acknowledges the holistic interplay of all three domains and operates at the principled level will the culture empower students with automated somatic markers that can be transferred from social situation to social situation. Only when students view school as a safe and caring environment in which to live and learn, will they learn to take the calculated risks and take responsibility for their own social action.

A school culture that is based on rewards and punishment will not offer students consistent opportunities to transfer social skills, because students tend to view each social situation as an isolated instance in learning. In other words, there is no consistency in time, place, and manner. Every social action is rewarded or punished by persons in authority and is based upon idiosyncratic criteria. Students then acquire bits of information, but are not afforded the "grand picture." For example, teacher "A" marks students tardy if they are not in their seats one second after the bell rings and teacher "B" allows students all the time they need to make it to class. When rewards and punishments are meted out by teachers, and stem from unilateral teacher-centered decisions, students learn to obey the teacher; they do not become responsible learners. A rewards and punishment culture encourages codependency and obedience by the student. Students who view school as a limiting and restrictive environment in which to live and learn are less likely to take responsibility for their social actions; they will simply learn to be obedient to certain authorities in a specific time, place, and manner.

Students activate specific neuronal circuits or schemata in response to a personally constructed perception of their environment, which is mediated by their learning within culture. The perceived environment may be "real" or "imaginary," perception is personal. To illustrate this point, consider this simple experiment. When asked about who signed the Declaration of Independence first, in big handwriting, many people schooled in the continental United States respond with the name "John Hancock." This fact is generally taught in fifth grade social studies classes across the United States. John Hancock was the first person to sign the Declaration of Independence and he wrote his signature in big handwriting so the King of England would not have to wear his "spectacles" in order to read his signature. In fact, this story has become so much a part of continental United States culture that many people living in the continental United States tacitly expect others to know what they meant by asking them to "put their John Hancock right there." It is expected that the person will hand write their signature on a piece of paper.

To conduct the experiment, ask someone who was schooled in the continental United States, "Who was the first person to write his signature on the Declaration of Independence?"

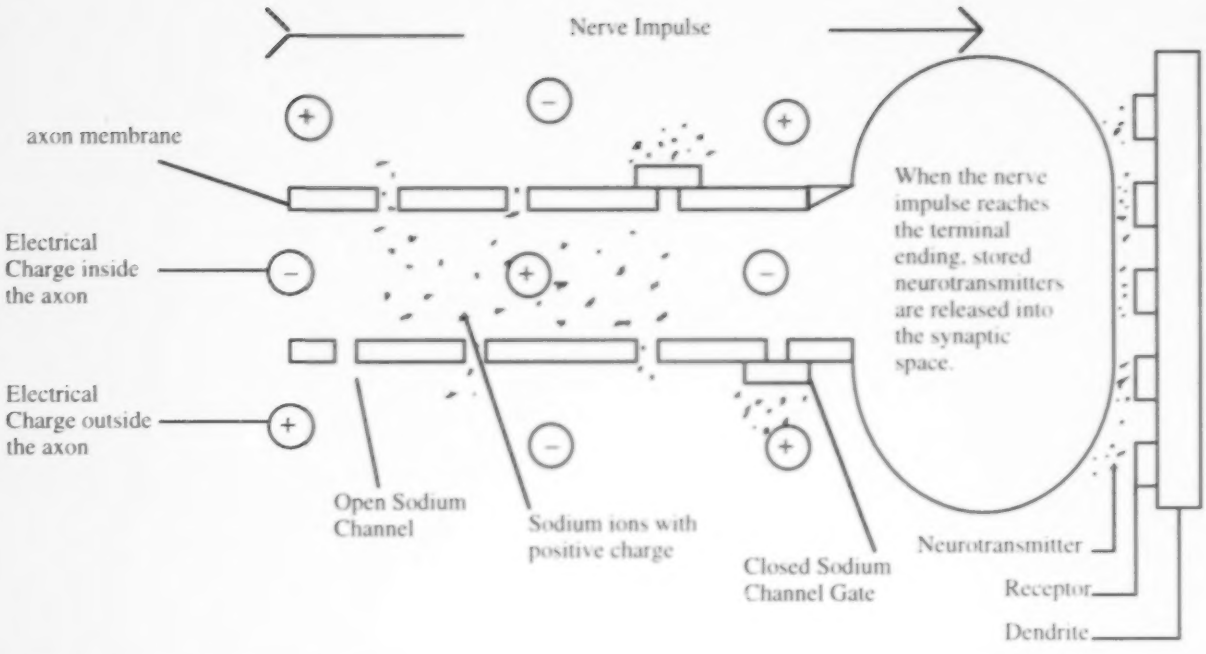
After the person responds "John Hancock," ask this question, "What is a key signature?" Generally the person will be dumbfounded and unable to respond. Ask them to think about it. "What is a key signature?" Is John Hancock's signing of the Declaration of Independence a key signature? Is the signing of any legal document a key signature? Many people will be puzzled by this question because the neuronal circuits, or schema, responsible for knowledge about the "signing process," the schema of peoples' signatures, have been activated by the previous question about the signing of the Declaration of Independence. However, when the word "music" is mentioned, a whole new set of neuronal circuits (new schemata) are activated in the person's brain and this provides him or her with a new "environmental and/or cultural context;" and thus a new meaning for the term "Key Signature" can emerge. If the person possesses knowledge of music, s/he will probably respond, "A key signature is a group of sharps or flats to the right of the clef sign on a musical staff."

This illustrates the importance of perception and cultural context in providing rational responses to problematic situations. Consider that students who perceive the environment as a limiting and restrictive place to live will constantly activate schemata that is dramatically different from the schemata activated by students who perceive their environment as free and caring. A student's perception of her/his environment is important in determining how s/he will behave and learn.

All Learning is Biological

As fantastic as it seems the sophisticated thinking processes and concomitant cultural ways of knowing of every individual have microscopic origins. The ultimate unit of action in the brain is a biochemical messenger called a *neurotransmitter*. Neurotransmitters are molecular structures that relay information from one neuron to another. "If... neurons are the processors of information, then the brain chemicals [neurotransmitters] are the languages through which information processing is carried out." (Levinthal, 1988, p.53)

Communication between brain cells occurs when stored neurotransmitters in one brain cell are released from the axon terminals (nerve endings). They move across a synaptic gap (a space between neurons as neurons never touch each other), and attach themselves to specific neurotransmitter receptors on the dendrites (receiving cables) and cell body of the receiving neuron. The communication effect that neurotransmitters have on the receiving neuron is either to excite or inhibit the receiving neuron, depending upon the receiving neuron's electro-chemical alignment. There is an electric charge across the membrane of the neuron; a charge of about one tenth of a volt, positive on the outside and negative on the inside. When a neuron "fires" this charge reverses sending a "nerve impulse" in a wave from the cell body, down the axon, to the terminal endings. This is known as "exciting" the neuron, when enough neurotransmitters attach themselves to the receptors on the dendrites and cell body and a critical threshold is reached, bio-electrically, the receiving neuron opens sodium gates in the axon, beginning nearest the cell body, and allows a cascade of positively charged sodium ions to rush inside the axon and open other sodium channel gates further down the axon as the positive charge moves toward the terminal endings. When the electrical charge finally reaches the terminal ending, biochemicals are released into the synaptic space between neurons.



It takes the neuron about a thousandth of a second to recover to a "resting state" after firing. When "excited," it is possible for neurons can fire thousands of times per second or just a few times every second; and some neurons, that are "inhibited" by biochemical activity, simply remain in a "resting state" and do not fire at all.

Neurotransmitters communicate with other neurons by making them "more" or "less" likely to fire. Neurotransmitters tend to inhibit communication between neurons when the message they carry affects the electrical charge of the receiving neuron by opening chloride channels in the cell body. This allows negatively charged chloride ions to enter the cell body of the neuron. The chloride ions make the brain cell more negatively charged on the inside. As a result, the surrounding biochemicals and neurotransmitters binding to the receptors on the dendrites of the neuron must overcome a greater negative electronic charge, or threshold, before the neuron can "fire." The greater the number of chloride ions, the greater the negative charge in the neuron or the greater the threshold, and the less likely it is to pass the message on to the next neuron by firing or activating a "nerve impulse" (Ornstein & Thompson, 1984).

A brain cell's firing or "nerve impulse" is an all or nothing process. It is a change in the electrical charge of a neuron. A nerve impulse is always the same, it is all or nothing, the neuron either fires or it stays at rest. The only variable during a nerve impulse is the speed at which the nerve impulse travels down the axon to the terminal endings. Some neurons take more *time* to pass on the message to other neurons, because they simply do not fire very fast or often. The speed at which any given neuron fires can vary from one kilometer per hour to two hundred kilometers per hour.

Unlike the nerve impulse, the synaptic transmission of neurotransmitters is a "graded" form of communication. Any given neuron, for a variety of reasons, could release huge numbers of neurotransmitters into the synaptic space or relatively few. The graded communication occurs because the more neurotransmitters released and the greater the receptivity of the dendritic receptors, the better the chances for exciting the next neuron and causing it to fire.

Both the "all or nothing" nerve impulse and the "graded" neurotransmitter release are needed to transfer biological information from one brain cell to the next (Kandel, *et al.*, 1991;

Levinthal, 1990; Ornstein & Thompson, 1984). It is through this incredible act of neuronal communication, multiplied billions of times, that human beings perpetuate a "genetic" cycle of learning which consists of genetic coding, experience, and metaphorical imagination, behavior, and biochemical and neuronal adaptation.

The Genetic Cycle of Learning -

The term "genetic" cycle of learning is used in this article as both a figure of speech and a literal interpretation. As a figure of speech, "genetic" infers a learning cycle that feeds on itself, whose "genesis" is manifest in its past and whose future is dependent upon the present action, reaction, or inaction. As a literal interpretation, "genetic" refers to a neurological process where neurotransmitters affect the "genetic coding" within brain cells. This literal interpretation is articulated by Kandel, *et al.* (1991) as they discuss the relationship between genes and behavior:

> Genes are essential not only for producing the appropriate neural circuitry of a behavior, but also for regulating the expression of the behavior in the adult, because genes code the structural proteins necessary to maintain the neuronal circuitry as well as for enzymes - including the transmitter-synthesizing enzymes that are essential for normal synaptic transmission. Moreover, genes directly code for peptide hormones and modulators that trigger or inhibit the expression of behavior. (p. 992)

This suggests that there is a link between genetics and behavior, and it is a complex relationship.

Educators must work with a multiplicity of individual personalities and learning styles in classrooms daily. Good educators know that every individual is different. For years biology courses have taught educators about these differences through knowledge of human conception and the probabilities of inheriting different physical characteristics from parents. These courses teach that when the egg is fertilized, information is coded on genes and that many of the approximately one hundred thousand genes will dictate an individual's physical characteristics. What is not generally taught, is that along with the genes that ultimately determine an individual's physical characteristics (male/female, fair/dark skin), there is also a set of genes that determine certain personality characteristics (Restak, 1994).

Students come to the classroom with a propensity for action, thought, and feeling, much of which is genetically inherited from their parents in the same way they inherit their physical attributes.

> ...Dr. Frank A. Elliott, professor Emeritus of Neurology at the University of Pennsylvania School of Medicine...has spent a lifetime studying violent people, [and] is convinced that genetic inheritance is one of the biological factors influencing the capacity for aggression. This capacity is mediated by a system of neurons and neurotransmitters extending from the prefrontal cortex down to the lower brain stem. "Most of this equipment is situated in the deep central portions of the brain which we have inherited, almost unchanged, from our reptilian and early mammalian ancestors," says Elliott. Experiments have made it clear that electrical stimulation of key sites along this pathway within the limbic system can provoke angry aggressive behavior or childhood predatory attacks. (Restak, 1988, p.283)

As will be more thoroughly discussed later, it is logical to think that individual students can inherit a propensity for aggression through a genetically acquired deficiency in neurotransmitters (serotonin levels) that leads to impulsive, injurious aggression and a reduced self-esteem.

> Not only intelligence but such personality factors as shyness, introversion, and susceptibility to certain forms of mental illness are turning out to be heavily influenced by genetics. This does not at all portend a gloomy determinism; life experiences can sometimes modify the basic personality, even transform it into its opposite. (Restak, 1994, p.99)

Personalities can be changed; our students do not have "solid state" neuronal circuits and set levels of biochemical activity. Students can alter their personalities by "cultivating" new nerve endings

(dendrites and axon terminals) that "grow" and reach out to communicate with other neurons; and remember, the number of possible connections in a normal human brain are virtually limitless (Kandel, *et al.*, 1991; Restak, 1988; Squire, 1987).

Phosphorylation is one neurological process that can affect a brain cell's genetic code (Kandel, 1994). It is a complicated process that is best described by beginning at the end and working backwards to its origin. Genes are coded by "...various combinations of the twenty amino acids and four nucleotides that make up our proteins." (Restak, 1994, p. 99) These proteins make the individual what s/he is mentally, physically, and emotionally. Some genes have two segments on which proteins arrange themselves in a genetic code. One segment is the message and the other determines whether the gene will be "read or transcribed," i.e., whether the gene will be eligible for action. This second region of genetic coding activates or deactivates the gene by the binding of specific proteins. Only genes that have a particular characteristic, called *cyclic AMP recognition element*, can be switched on and off by the binding of proteins. Not every gene in the body has this "switching characteristic." There are thousands of genes that will never be affected and these are the genes determining hair color, skin color and the color of our eyes; these genes will never be affected. But, there are also thousands of genes that can be turned on and off by a *cyclic AMP recognition element binding protein*. When genes are turned on and off by this neurological process we literally change the genetic code of the brain cell. It is thought that specific genes are "turned on" to produce the proteins that are essential for learning and long term memory. Kandel, *et. al.*(1991) have found that learning and long term memory **require** protein synthesis and changes in genetic coding at the cellular level.

The Importance of Serotonin

One of the primary neurotransmitters involved in phosphorylation and essential for learning and memory is serotonin. Serotonin strengthens the synaptic connections between nerve cells involved in learning and memory by activating secondary messengers that phosphorylate proteins within the cell. When Serotonin binds to a brain cell's receptor, one of the things it can do is activate an enzyme called adenylyl cyclase. This enzyme converts a molecule that powers the brain cell, ATP, to a secondary intracellular messenger, cyclic AMP. Cyclic AMP activates another enzyme, a protein kinase, which adds phosphate groups to other proteins. This phosphorylation of proteins increases or decreases the activity of the proteins (Kandel & Hawkins, 1992). In other words, it switches the proteins "on" or "off." If serotonin is repeatedly applied to the same brain cell, protein kinases not only act on the proteins within the cytoplasm of the cell, but they will also act on genes within the nucleus. The serotonin induced protein kinases will also affect the genes that give rise to neuronal growth and the genes that make the kinases persistently active even in the absence of cyclic AMP (Kandel, 1994).

So, what does all this mean to the average educator? **Serotonin is absolutely essential for learning and memory** (Kandel, 1994). Without this neurotransmitter students will learn nothing, because they will retain nothing! This means that serotonin is involved in all aspects of cognition and behavior.

Serotonin is not only essential for learning and memory it is also involved with mediating self-esteem and social behavior. One of its roles is to inhibit aggressive behavior. Raleigh and Brammer (1993) found that monkeys displaying social behavior that is well aligned with group expectations tend to have greater serotonin activity and greater numbers of serotonin-2 receptors in the specific areas of the brain that are concerned with social behavior than monkeys who display antisocial aggressive behavior. They also found that when serotonin activity was blocked in the more social monkeys, they were more likely to display impulsive, injurious aggression. "In general, enhancing serotonin function reduces aggression and favors social behavior." (Damasio, 1994, p.76)

It is simply fascinating to think that serotonin is linked to both feelings of self-worth and social behavior, and at the same time to learning and memory. Experienced teachers have tacitly known for years; students who have high self-esteem and tend to be intrinsically motivated to act in socially appropriate ways are more likely to learn and apply the knowledge, dispositions and skills taught in the various academic disciplines. These students also tend to be more involved in extracurricular activities than those students who feel inadequate and are denied perceptions of self-worth. The implications for schools and teaching and learning are clear. Serotonin is a biochemical link between behavior, cognition and feelings of self-worth. The educational response is to provide a school culture that gives students feelings of permanent value, where students do not need to prove themselves in order to fit in the social group. This, in turn, helps to raise students' levels of serotonin, improving social interaction and learning and memory. A healthy school culture helps to develop the neuronal circuits and biochemistry needed to be a viable and healthy human being.

Still, some will argue that a better avenue and a quicker solution for those lacking in socially appropriate behaviors is found by using drugs to complement an individual's physical need for greater serotonin activity. Certainly drugs, like Prozac, have a role to play in realigning some students' behavior with the social norms and expectations for proper schooling. However, prescription drugs should be a last resort as there is always a danger associated with applying a "shot gun" technique to a problem that needs "pin-point" accuracy. For example, Prozac is often prescribed for depression and it acts to clog the reup-take of serotonin from the synapse. This allows serotonin to remain in the synaptic space longer and has the effect of supplying receiving neurons with more serotonin. However, it affects all serotonin receptors in all parts of the brain at once, a shotgun effect. A risk exists for individuals who are not biochemically deprived in certain areas of the brain and who are then effected by an influx of biochemical activity that affects other biochemicals and enzymes in the body (Cooper, Bloom & Roth, 1991). When dealing with normal students a more holistic and natural approach is to affect neurological and biochemical change through *experience* and *metaphorical imagination*; and these have much to do with a healthy school culture.

It is difficult to paint an accurate picture of the brain and its functions with the broad brush of a single neurotransmitter, like serotonin, because there are in fact no fewer than fourteen different serotonin receptors found in the brain. So, generalizing about the brain and behavior based on one aspect of a single neurotransmitter, without considering other factors, would be inappropriate and possibly inaccurate. It is important to first determine where a biochemical is located in the brain before we can predict what its effect will be on the individual. No single gene and no single neurotransmitter can be held accountable for any given behavior, and no one neuron or neuronal circuit can be held accountable for personal action. It is a complex and holistic interplay between biochemicals, neurological connections, and electrical impulses that determines an individual's behavior and her/his interaction with the environment. The number and types of neuronal connections, the composition of biochemicals, and the polarity of electrical valences within the neurons are all important variables in determining what predisposes individuals to certain ideas, beliefs and actions. Concomitantly, an individual's perception of the environment's reaction to her/his action affects all of these variables, and results in a new personalized construction of *reality*.

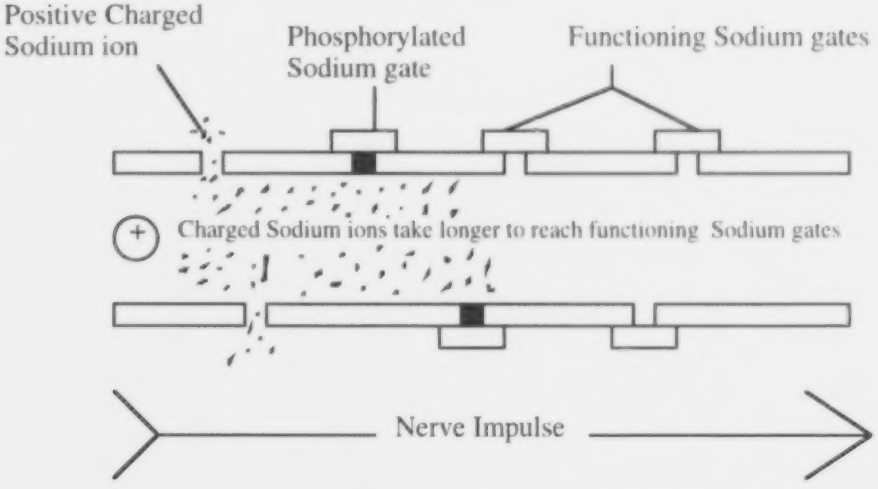
The brain's architecture and biochemistry mediate all individual perceptions of reality, and all individual realities are concealed in the genetic makeup of the individual's biochemistry and neuronal physiology. These individual realities, in turn, increase or decrease the likelihood that certain neuronal circuits or schemata will be activated, and that certain action will be taken.

The Importance of Time -

It takes *time* to construct the neuronal connections and transfer learning from short-term memory to long term memory. In his work with the marine snail Aplysia, Eric Kandel (1992) found there is an important "consolidation" time after learning. "Consolidation time," is a time when the proteins are phosphorylated and bind to genes with *cyclic AMP recognition element* in affected brain cells. If consolidation time is not allowed, the learning will not be transferred into long term memory and learning will fade from memory. So, *time* is critical to learning and memory and there is a need to provide time for consolidation.

Time is also an important variable in the activation of neuronal circuits or schemata. In fact, time is such a critical variable to the activation of neuronal circuits that neuroscientists measure brain cell activity in *milliseconds*.

Phosphorylation can effect proteins that regulate the sodium and potassium channels in a brain cell. For example, protein kinases can alter sodium channels in the axon membrane of a brain cell. They act by "clogging up" some of the sodium gates so they cannot open during a nerve "firing" or impulse cascade. This form of protein kinase not only effects the brain cell's nerve impulse (the flow of electricity that precedes the discharge of neurotransmitters into the synaptic space), but it can also affect the brain cell's genetic coding. It can act indirectly upon DNA and thus physically change the brain cell's function (Kandel, *et al.*, 1991; Levinthal, 1990; Ornstein & Thompson, 1984).



It is logical to think that it probably takes longer for a phosphorylated brain cell's nerve impulse to travel along the axon to the terminal endings than if the brain cell had not been affected by the process of phosphorylation. Likewise, obstructing the potassium channels has a similar effect by allowing "...calcium channels to be activated for longer periods, " which takes the brain cell more time to recover and causes more neurotransmitters to be released into the synaptic space. (Kandel & Hawkins, 1992, p.83)

As mentioned earlier, a nerve impulse can travel between one kilometer per hour and two hundred kilometers per hour; and phosphorylation probably has some affect on the rate at which a nerve impulse fires. Consider that the retarded electrical action of phosphorylated brain cells may be the result of a perceived need in the individual to slow the activation of specific neuronal circuits or schemata. This slow response by phosphorylated brain cells allows for other brain cells with faster nerve impulses and recovery times to activate first.

The coherence of perception comes out of "time" rather than "space" itself (Damasio, 1994) There is no one place in the brain that holds meaning, rather meaning is acquired from many

different parts of the brain through parallel processing of information and activation of schema. The faster brain cells are probably responsible for activating "stereotypical" neuronal circuits or schemata that are repeatedly used as responses to real and imagined stimuli. Certainly, there is little time wasted in activating these neuronal circuits as we almost subconsciously play out the stereotypical response. For students genetically predisposed to violence and whose environment is perceived as coercive and threatening, their stereotypical response to any problem situation or "sign stimulus" will probably be to activate some form of aggressive behavior. When these students feel little choice, their only recourse is to act out in a hostile fashion. Generally, it is a response that they have rehearsed and imagined many times and have fine tuned to achieve a desired response. However, if these students are given more *time* and opportunities to imagine different choices, these same students will probably learn to activate alternative neuronal circuits or schemata.

Neurological *time* and choice are important to us all, and when they are not accommodated problems can arise. For example, a student teacher I was supervising had been using a cognitive form of classroom management successfully with his first grade class. But some teachers told him that he was not tough enough with the students. So, he decided to make a stand and assert his authority over the class. His class included a boy who was a State wrestling champ for his age group and he had the size and build that went with that athletic role. This boy was also prone to impulsive, injurious aggression. A confrontation between the boy and the student teacher left the boy sitting on the sidelines of a class softball game, a punishment deemed appropriate by all but the boy. When the boy tried to re-enter the game, the confrontation accelerated until the boy felt no option but to attack the teacher. Fortunately, the student teacher was able to gently restrain the boy until the boy had *time* to regain his composure. When I debriefed the situation with the student teacher, we realized that the boy had been given no choices and he felt powerless in that situation. We determined that even structured choice would have been better than no choice. When thinking back on the situation, neither *time* nor choices were allowed the boy. We ascertained that the punishment, sitting out of the game, probably was perceived as a sign stimulus by the boy and that this activated what was probably the boy's stereotypical response, to strike out at the obstacle in his path, which was the student teacher. If the boy had been allowed *time* and choice the situation probably would not have manifest itself in physical violence. *Time* and choice are great pacifiers. Two crucial components for maintaining a healthy "genetic" cycle of learning are *time* and context or choice. These two educational resources, that all educators have available to them, need to be used and judiciously administered.

In theory, neuronal and biochemical adaptation, behavior, and new experience maintain a perfect "genetic" learning cycle. These elements contribute to the perpetual cognitive, affective, and psychomotor conditioning and reconditioning of every individual throughout her or his lifetime. However, in order to maintain a perfect "genetic" learning cycle, neurotransmitter activity has to be kept in balance through optimal biochemical synthesis and transmission; this is known as *homeostasis*. Too much or too little biochemical activity over a long period of time can make us ill. Our physical/mental state can become unbalanced and offset the perfect nature of a healthy "genetic" learning cycle (Kandel, *et al.*, 1991; Levinthal, 1990; Restak, 1988; Beck & Beck, 1987, Ornstein & Thompson, 1984).

The Importance of Homeostasis -

The brain/body strives for balance through moderation and optimization. Much of what the brain does is about inhibition, not excitement. If all the brain does is excite the body, there would be no control at all. If there is too much activity, the brain/body becomes diseased and stressed. If there is too little activity the brain/body becomes depressed and anxious. The brain/body constantly strives for a homeostatic balance. It wants to be healthy and normal. It is mainly the outside influences and individual perceptions of the environment that disturbs the homeostatic balance and affects the healthy genetic learning cycle of every individual.

Endorphins and Addiction to Media Messages -

Endorphins (**Endo**genous Mor**phines**) are very powerful peptides, composed of small chains of amino acids. They act as neurotransmitters and are involved in maintaining health, mediating emotions, pain, and stress, and providing intrinsic reward (Kehoe, 1988). They perform these functions by relieving pain and/or inducing feelings of pleasure. There are three separate families of endorphins (Enkephalin, Beta-Endorphin, and Dynorphin) and there are many different endorphins within each family. Still, they all share an ability to cause euphoria and/or numb pain (Levinthal, 1988).

Endorphins are released from the terminal endings of neurons when animals are under stress and, in human beings, they may also be released in response to an emotional experience. Any stress or emotional experience, whether real or imagined, can cause the release of multiple forms of endorphins. Hence, exposure to mediated experiences that provide new and exciting, stress inducing, and/or emotion laden sensory experience, can cause the release of endorphins within the brain, resulting in a feeling of euphoria and/or "no pain." These mediated experiences may be in the form of viewing films, TV programs, videotapes, plays, listening to the radio, CD's, tapes, reading books, magazines, newspapers, interacting with computer games, programs, and networks. Any or all of these media can affect various individuals, as long as the message is perceived as exciting, stressful, or emotion laden.

Avram Goldstein (1980) researched the effects of music and other stimuli that can cause endorphin release, which he said caused subjects to experience a "thrill." A "thrill" he described as,

> ... a chill, shudder, tingling, or tickling. It may be accompanied by a feeling of "hair standing on end" or "goose bumps" on the arms. Thrills are invariably associated with sudden changes in mood or emotion. They may be accompanied by sighing, palpitation, tension of the jaw and facial muscles, a feeling of "lump in the throat," or incipient weeping. Some respondents noted a certain similarity of thrills to orgasm, but with many reservations concerning quality and intensity. Thrills were stated to be pleasurable... (p. 127)

Goldstein also observed,

> The typical stimulus that elicits a thrill is a confrontation with an emotionally stirring situation or event, such as a natural scene of transcendent beauty, a magnificent work of art or drama, a musical passage, a poignant personal encounter, a rousing speech, or a sudden intellectual insight. Even imagining these stimuli can be effective. In people who experience thrills, there is invariably more than one kind of effective stimulus. The single generalization that seems to apply is that the thrills are associated with emotional arousal. (p. 127)

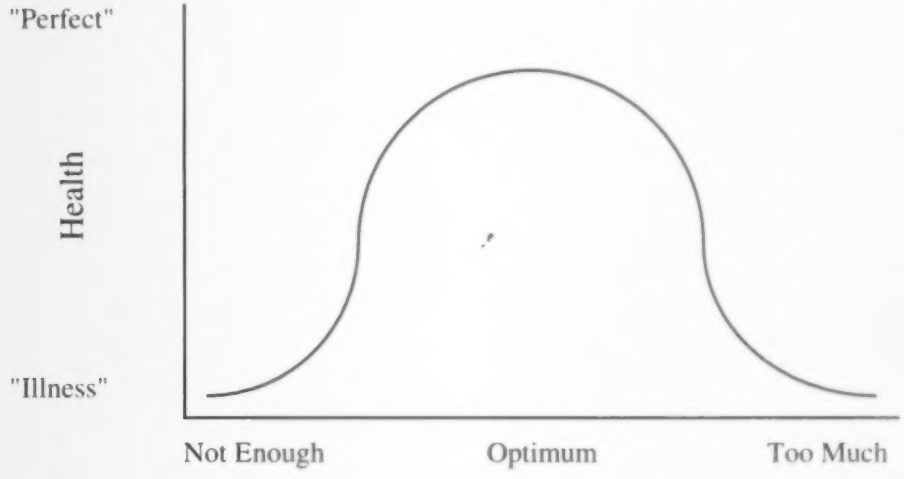
Goldstein concludes that it is "obvious conjecture" that these thrills are mediated by the endogenous opioids (endorphins) in our brain.

Endorphins have important biological roles to play in human survival. It is thought that endorphins help protect against pain by acting as a critical mechanism for avoiding pain. They are also involved with feelings of social comfort. In fact, some neuroscientists say endorphins may be responsible for feelings of positive reinforcement, which lead to repetitions of successful behavior (Levinthal, 1988). Endorphins are necessary and beneficial to the healthy human condition, provided they are distributed in a balanced and optimum fashion (Beck & Beck, 1987).

Endorphins can be physically addicting in exactly the same way heroin and morphine can be physically addicting (Kandel, *et al.*, 1991; Gathercoal, 1990; Levinthal, 1988; Kehoe, 1988; Beck & Beck, 1987; Ornstein & Thompson, 1984). In fact, all humans are addicted, to a certain extent, to endorphins. We physically need them. We must maintain an optimum amount of endorphin activity in the brain in order to remain "normal," just as a heroin addict needs an

optimum "fix" injected into her/his blood stream to remain "normal." Endorphins are different, however, in that they do not have to be injected; they are already in our bodies and simply need to be released. We remain healthy and normal when our endorphin activity is complementary to our physical needs.

Think of healthy endorphin activity as a bell shaped curve. Our health (on one continuum) is "perfect" when the optimum amount of endorphin activity is present (on the other continuum). This is the healthy homeostatic balance the brain/body strives to maintain.



Endorphin Activity

Our health is affected when there is an **oversupply** of endorphin activity, which may be signaled by a "high" or a "thrill." It is also affected when there is an **under supply**, which leads to symptoms of opiate withdrawal.

To illustrate this point, a parallel can be drawn between an endorphin under supply and the symptoms of heroin addiction withdrawal. Heroin addicts display withdrawal symptoms of panic, distress, a display of sorrowful emotion and a strong desire to be reunited with their source of immediate gratification. Similarly, as endorphin levels become low, people may seek out the social stimulation that will reduce their distress and produce a form of reward or reinforcement for their social interaction.

Many of today's students may find feelings of reward and relief by viewing and listening to the messages of the media. It may be that some students are **addicted** to the media as a source for maintaining an optimum level of endorphin activity in the brain and stimulating the occasional "thrill," all of which can lead to repetitive behavior. "When endorphin levels are low,..., there is an innate tendency to seek social stimulation. These social stimuli then lead to a release of endorphins that not only reduces the separation distress but also produces reinforcement or reward for the behaviors of social interaction." (Levinthal, 1988, p.145)

Some students spend so much time viewing TV that they perceive the TV personalities as their "friends." By spending social time with them, vicariously through the stories on TV, students experience endorphin release in the brain. Some may empathize with the characters as they share in the loves, friendships and sorrows of their favorite TV characters. When we are addicted our view of the future is narrowed and almost nothing but the here and now are processed with clarity. Isn't it fascinating that most people care more about which news personality is anchoring the TV news report than the news reports and world affairs presented on the newscast.

This idea of **addiction to media messages** fits well with DeFleur and Ball-Rokeach's (1990) dependency theory. Dependency theory suggests that individuals are actively involved in constructing their own personal media system; and these systems provide individuals with personal rewards to the extent that individuals become dependent upon the media system he or she creates. Endorphin activity in the brain may be the source of reward associated with a personally constructed media system. These addicting neurotransmitters may ultimately be responsible for creating an individual need and/or desire for daily exposure to certain media messages and mediated experiences. Think about it, what media messages are you exposed to daily, that you would not feel "normal" without? Do you need your daily newspaper? A dose of sports programming on TV? Can you go without browsing the Web? Is there a favorite computer game that demands your constant attention.

Endorphins are a necessary "drug." People strive to feel "normal" by maintaining an optimum level of endorphin activity (Levinthal, 1988). For individuals who are addicted to mediated experience as a source for stimulating endorphin activity, feeling normal may mean spending 20-30 hours per week with certain media messages; and for others, it may mean spending up to 90 hours per week. We all have different biological needs. For those who need heavy exposure to media messages there can be adverse effects on their health.

One health effect is **desensitization**. If media messages are stressful and/or thrilling, they can induce endorphin activity (Gathercoal, 1990) and endorphins act on our brain cells like drugs.

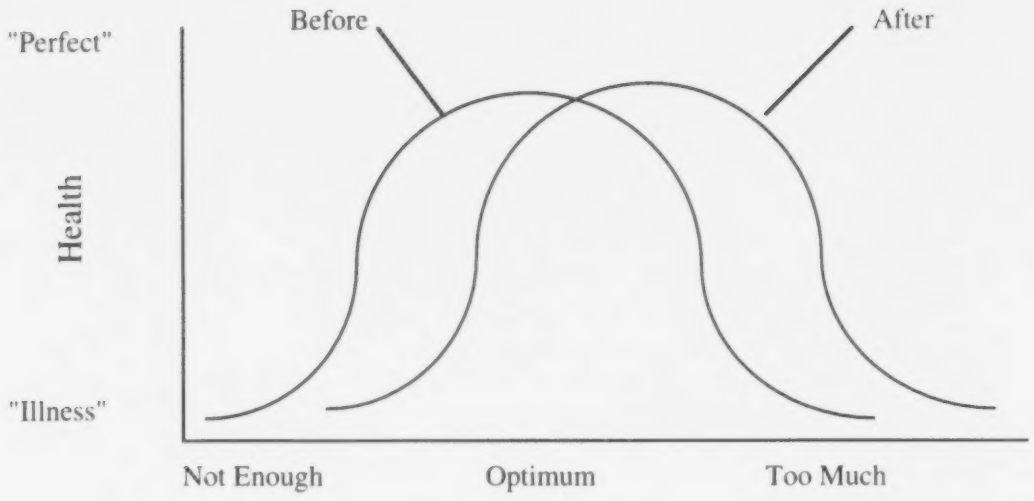
> When the brain is flooded with an unusually large quantity of a drug, the nerve cells respond by cutting down the number of receptors. That's why drug abusers need more and more of the drug to get the same effect. Then, when the drug is taken away, the brain's *natural* chemicals have fewer receptors to lock onto...the result is an increase in anxiety and "nervous excitement." That's withdrawal...Opiates such as morphine and heroin produce an intense withdrawal reaction... (Restak, 1988, p.132-133)

Endorphins connect to the same receptors as heroin and morphine. Have you ever had a friend come over for dinner, only to have them leave early so they could get home in time to watch a favorite TV program? Have you ever tried to call the children to the dinner table as they sit like deaf mutes in front of the TV?

Media messages allow individuals opportunities for vicarious rehearsal of life experience and as a result, individuals are conditioning their brain/bodies to be unable to fully appreciate a similar experience in their own lives. By previewing stressful and/or emotional portrayals of life experiences on television and other media, people are neurologically and biochemically adapting to handle similar stress and pain in their lives. So, the next time they see someone killed in cold blood, it is not likely to be so shocking; and individual may respond, "I've seen worse."

Research conducted by Yoshio Hosobuchi at the University of California in San Francisco in 1977 supports this notion of building a tolerance to endorphin activity. Hosobuchi attached electrodes to the PAG (periaqueductal gray) region of the brain in six patients suffering chronic pain from cancer. A hand-held, battery operated transmitter was used to stimulate endorphin activity in the PAG region. As a result, five of the six patients no longer had to take opiate drugs and they reported total relief from pain. Howeyer, the hand-held transmitter had to be used sparingly, in short bursts and with a period of rest in between, otherwise the patients would build up a tolerance and the stimulation would be ineffective (Levinthal, 1988). This supports the notion that too much endorphin activity can lead to desensitization and habituation that is marked by the retraction of synaptic connections in the PAG region of the brain.

In essence, individuals can move their homeostatic need for endorphins further along the "normal" continuum. The resulting physical condition is one where more and more endorphin activity is needed in order to feel "normal" (Kandel, *et al.*, 1991; Levinthal, 1990; Ornstein & Thompson, 1984).



As the chart indicates, the affected individual will need even more endorphin activity, more often, in the future in order to feel "normal" the next time s/he encounters a similar stress inducing and/or emotion laden experience.

Another health effect related to endorphin activity is closely linked to modeling theory. DeFleur and Ball-Rokeach (1990) explain,

> The media are a readily available and attractive source of models. They provide symbolic modeling of almost every conceivable form of behavior. A rich literature has shown that both children and adults acquire attitudes, emotional responses, and new styles of conduct from all the media, and especially from films and television. (p. 216)

There may be a carry over effect from media messages to real life. Consider that media messages can affect strong endorphin "thrills" and that the accompanying metaphorical imaginations associated with this endorphin activity is very memorable to the individual (Goldstein, 1980). Such positive feelings, associated with endorphin activating media messages, may motivate students to experiment with their imaginings in the real world environment. A girl or boy may transfer her/his imagined behavior to real world action in response to problematic situations and in hopes of achieving positive reinforcement in the form of a similar or even greater "thrill" than was ever imagined while viewing and listening to the media message.

Most film and television media messages preach at the audience. They do not often allow the audience the opportunity to work through moral dilemmas associated with the stories they tell. Instead, they usually provide the context/problem, and the solution. In this regard they act as moral dictators operating at the lowest levels of moral development. The implicit principles on which many of the moral decisions are based are rarely made explicit. Instead, the audience is shown behavior and not cognition.

> ...young children are often unable to relate a series of complex actions to their final consequence. Thus, when industry spokespersons claim that their programs are fundamentally prosocial because good ultimately triumphs over bad, they ignore this important finding. The young child is much less likely to make the interpretive connection and, therefore, less likely to learn the moral lesson. (Rubinstein, 1983, p.821-822)

Television simplifies moral dilemmas and models lower level moral problem-solving for complex problems. Often the stories television tells are glorified by peer group interaction. Students talk

about things that happened, concentrating on endorphin activating happenings within the message, ignoring critical aspects of the story that are not new, novel, exciting or culturally significant as "sign stimulus."

Television has a direct visual link to the limbic system (the emotional center of the brain) via a neuronal network originally designed to detect changes in odor through the sense of smell. A significant feature of this sensory center is that it was designed to block out different odors after a period of time and think of the environment as normal. The system would only activate again when the odor changes. Now, the area has evolved to include visual information as well. This is why the brain responds to new or novel visual information and disregards things that appear to be "normal." It is a legacy of our pre-historic past. (Levinthal, 1988)

So, students who view many hours of high action/high violence films and television often find real life "dull and boring." When attempting to transfer modeled behaviors from the film and television world to the "real" world, students may not experience the euphoric reward they experienced while watching actors perform the same actions on the screen. When they try to emulate the imagined experience, they may have lost the ability to fully appreciate the real experience because they have been desensitized by too much endorphin activity. If an oversupply of endorphin activity is present, an individual would not be predisposed to finding intrinsic rewards in the same way a "normal" individual would find reward through social relationships. Such individuals would be unable to show emotional response in social settings; they would have no biochemical need to interact with others. As well, they may not fully appreciate the consequences of inflicting physical pain on others and would display a general lack of emotion (Levinthal, 1988). Given these arguments regarding endorphin activation and desensitization and modeling via certain media messages, it can be argued that exposing children to television programs, computer games, and other powerful media messages, without providing them with a media education, is a form of child abuse, a form of social deprivation.

Media messages that make students feel anxious can also stimulate endorphin activity. When students expose themselves to media messages that generate feelings of anxiety (horror and suspense films can do this) their bodies release neurotransmitters that attach themselves to "anxiety" receptors. This action makes them feel nervous and distraught. Since the human body has no tranquillity receptors to bring them down from these feelings of anxiety, endorphins are released to provide analgesia and a feeling of euphoria that simulates and encourages tranquil behaviors (Kandel, *et al.*, 1991). Media messages that make students anxious, such as horror and suspense films, arcade type computer games with life and death scenarios, and emotion laden news, promote the release of endorphins in response to feelings of anxiety. In this way, endorphins are also implicated and play an important role in *desensitization* to horrific mediated and real life events. At the same time, they help to create a physical dependency that encourages individuals to seek out some similar experiences, which provide them with feelings of anxiety and concomitant feelings of "tranquillity." This may explain why so many children "enjoy" films and video that portray violent acts and that are classified for Restricted Audiences Only (S.A. Council for children's Films and Television, Inc., 1986). Many of today's children like to scare themselves, because it feels good when the endorphins are activated.

Many of our students probably find high action/high violence media messages irresistibly stressful, causing the release of copious amounts of endorphins and inducing a trance-like state interrupted only by the occasional "thrill" which then sedates them again by dulling their pain receptors. It's hard for real life experiences to match that level of endogenous reward. After children, in particular, have grown used to the thrills and chills of high action/high violence video, their school activities, family picnics, and other sources of real-live-action social situations may seem pretty ordinary and unsatisfactory. As a result, they may display an inability to respond emotionally to social relationships and affection, or appreciate the full impact of pain; they may also display a lack of desire for companionship, and a persistence with repetitive patterns (stereotypical responses) that are not associated with external reinforcement (Levinthal, 1988).

Some neuroscientists believe, "Socially appropriate behavior may be learned through the reduction of anxiety that comes when one decides *not* to engage in antisocial behavior." (Restak, 1988, p.312) These individuals find feelings of anxiety uncomfortable and avoid them by creating an environmental context where neurons that release neurotransmitters that attach themselves to "anxiety" receptors are inhibited. However, there are other individuals who may find that anxiety is pleasurable, due to the accompanying release of endorphins; and these individuals may escalate their antisocial behavior in search of the endorphin release that flows along with feelings of anxiety. Consider that many of today's students who are predisposed to violence and who enjoy more and more endorphin activity may become caught up in their own pleasure and be desensitized to the needs and interests of their living environment. Such a mentality can result from increased anxiety emanating from exposure to high action/high violence media messages. These students' perceptions of their immediate environment will be dramatically different from "normal" students' perceptions. Consider the following news accounts as artifacts of our modern world and speculate about connections between violent mediated experience and real-life behavior. Could there be an anxiety/endorphin link?

Queen Street killer's diary...

Diaries kept by the Queen Street killer, Frank Vitkovic, 22, showed developing insanity and admiration for the bullet-spraying movie cult hero Rambo, police say.

And at a police Press conference yesterday, further details of the former Melbourne University student's private life were released, including the fact that about 10 of 27 videos found in his bedroom were murder movies, many of them taped directly from television.

On Vitkovic's bedroom wall hung a huge color poster of Rambo in action, and a clipping about the fictitious warmonger, played by actor Sylvester Stallone, was found among his possessions. (The Advertiser, Saturday, December 12, 1987, p. 3)

Bundy: 'I deserve...punishment'

Condemned killer Ted Bundy told an interviewer ... that he "felt the full range of guilt and remorse" but that he had it "compartmentalized" in his brain.

He said it was "important to me that I'm not blaming pornography ... I take full responsibility." But he said hard-core pornography "guided and shaped" what he did.

After he committed his first murder, "What were the emotional effects on you? What happened in the days after that?" Dobson asked.

"It was like coming out of some horrible trance. ... It was like being possessed by something so awful, so alien."

"I was absolutely horrified that I was capable of doing something like that." (Corvallis Gazette-Times, Wednesday, January 25, 1989, p. A3)

Damasio (1994) found subjects with frontal lobe brain damage, who were shown highly emotive pictures of homicides did not behave normally, physiologically. These abnormal patients were able to describe, in words, "the fear, disgust, or sadness of the pictures they saw," but they did not exhibit the typical body-state associated with the viewing of horrific photographs. (p.210) Extending on from Damasio's finding, could it be that when an individual's emotional system is overloaded with neurological and biochemical activity, his or her thought processes are clouded and the normal somatic marker responses are neutralized by the high endorphin activity associated with "thrills" and emotional exuberance?

Boy, 5, stabs toddler...

A five-year-old boy made a bizarre stabbing frenzy assault on a toddler playmate -- apparently "inspired" by two horror movies.

He lunged and stabbed the 2 1/2-year-old girl 17 times, wounding her in the thighs, buttocks and face.

A witness told police that before the bloody rampage in Boston the boy was talking about "Jason," the ice-hockey-masked killer in the horror film Friday the 13th and "Freddy Krueger," the grotesque character who killed children with razor-like claws in A Nightmare On Elm Street.

The boy apparently had seen both of the violent films on television. (The Advertiser, Saturday, November 21, 1987, p. 6)

Consider, also, this account from James Vance, who after a prolonged bout of drinking and listening to songs by the heavy metal group "Judas Priest" made a death pact with his friend Ray. Ray put a shotgun to his throat and pulled the trigger. James Vance shot himself, but flinched at the critical moment and survived, although facially disfigured. He remembers that fateful night:

> And [Ray] said, "I sure fucked my life up." There was blood everywhere. I picked up the shotgun. I had no doubt in my mind, no second thoughts. I knew I was gonna' shoot myself. I was afraid, I didn't want to die... But I have - I mean, I was going to shoot myself. It was like I had no control over it. Cause I didn't want to die... And... I shot myself. (From "Dream Deceivers," Produced and Directed By David Van Taylor, 1991)

Later, James had this to say about the effect the music by the heavy metal group "Judas Priest" had on him and his friend Ray:

> Judas Priest sang a lot about the cosmos... Songs like "Epitaph," "Dreamer," and "Dream Deceiver" the music was just beautiful. We would get power from it and our emotions would just soar with the music... and then they would go up and down and up and down... **It was like a drug, like a narcotic and it wasn't just this one night [when Ray took his life and James shot himself]. It was always like that.** (From "Dream Deceivers," Produced and Directed By David Van Taylor, 1991)

How much say do we really have over our actions? In human beings, the frontal lobes of the brain have developed more than any other creature on Earth; enabling people to predict the consequences of their actions and operate within the social expectations of the group. This is commonly referred to as "free will." However, new developments in neuroscience indicate that:

> "...a body-based mechanism is needed to assist "cool" reason, it is also true that some of those body-based signals can impair the quality of reasoning... I see some failures of rationality as not just due to a primary calculation weakness, but also due to the influence of biological drives such as obedience, conformity, the desire to preserve self-esteem, which are often manifest as emotions and feelings." (Damasio, 1994, p.191)

How much "free will" is exercised when students strive to meet the social expectations attached to our rights and responsibilities of citizenship?

The Importance of Context and a Healthy School Culture -

Context is very important when talking about addiction to media messages. In her book, *Mindfulness*, Ellen J. Langer (1989) talks about addiction and context. She reports, "that heroin addicts are less likely to report withdrawal if they don't consider themselves addicts. Those who take the same amount of heroin and call themselves addicts often suffer much greater withdrawal symptoms." (p.183) Those who do not see themselves as addicts tend to use alternative neurological pathways that are not dependent upon the drug.

Langer (1989) cites the experience of Vietnam veterans as an example of alternative contexts affecting addiction. She points out that as the United States withdrew troops from the overseas conflict Veterans Administration hospitals were warned of the large numbers of soldiers who would need rehabilitation from heroin addiction. Yet, when the troops returned home, few showed up at the VA hospitals for treatment. So, when no one was showing up for rehab, the VA

went out and asked the soldiers what was going on. The soldiers then readily admitted that when they were in Vietnam they needed and used heroin, but when they returned home, they just didn't need it anymore. "Our perceptions and interpretations influence the way our bodies respond. *When the "mind" is in a context, the "body" is necessarily also in that context.* To achieve a different physiological state, sometimes what we need to do is to place the mind in another context." (Langer, 1989, p.177) It appears that there are several ways of accomplishing this task of placing the mind/body in a different context. One is move to a new environment, another is prayer or meditation, and others involve the use of drug therapy. These contextual change agents have real implications for culture and schooling.

When a problem situation develops and we find ourselves in the throes of emotion filled activity, educators and students need to learn to take time. Time and contemplation of choices keep us from acting too quickly or relying on "stereotypical response" mechanisms. It's more than the old adage, "Count to ten before you act." Individuals need to bring their mind/body state to a conscious level. We need to learn to recognize when emotions are high and the euphoria of the moment is in charge. We need to learn to control our emotions by taking time to think; withholding actions until the action can be evaluated via a balanced state of biochemistry that mediates holistically the individual's cognitive, emotional, and behavioral predispositions.

Providing students with the knowledge of how violent and emotion-laden media messages can affect our brain architecture and biochemistry, and concomitantly our thinking and action, is one step towards generating a new context for thinking about possible behaviors. When my son was in High School, he invited a friend over to our house to play video games. As the two were beginning to play the games, I touched my son on the shoulder and asked him, "Can you handle this?" He assured me that he could. I reminded him of other times he had played at length and how his actions, after play, were aggressive and spontaneous. We talked of the endorphin "thrill" and the biochemical imbalance that was about to take place and he again assured me that he could handle the situation. As it happened, he did handle the situation well and played for some hours with his friend. The knowledge of this neuro-biochemical phenomenon did much to help him control his anxiety during and after play and to take the time needed to deal rationally with problem situations. As a result of his deliberation and thoughtfulness he was able to create a different context for living and learning. He was able to take time and deliberately think of himself in another context, and thereby bypass the neurological pathways associated with endorphin "thrills" and video games play.

When educators practice cognitive forms of discipline, it helps students to construct a context that is perceived as fair, free, and caring. When a student truly believes that this is the state of the environment, the student is more likely to think of herself or himself as having value and as a result, s/he will be less likely to act out against people and things in the environment.

Will using cognitive forms of discipline solve all our problems in education? The answer is "no." In fact, there will continue to be problems. However, **using cognitive forms of discipline will not make things worse**, and **cognitive forms of discipline have the potential to make things better**. Educators who practice cognitive forms of discipline are less likely to be victims of revenge. Consider that some, not many, but some students display thinking and behavior like this:

> ...signs of irrational thinking are usually absent. They are egocentric and lack the capacity to feel empathy and love. They have little or no conscience or sense of guilt, tend to project blame when they get into trouble. They are unreliable, untruthful, and insincere, but they are often convincing because they believe their own lies. There is a vast gulf between what they say and what they do. They are impulsive, the whim of the moment being paramount. They are given to periodic and often senseless antisocial behavior which may be either aggressive or passive and parasitic. (Restak, 1988, p. 310)

This is the description of the violent psychopath. For these people, no discipline model will work well. They are not normal.

The educator who uses a cognitive model of discipline avoids power struggles and encourages students to take calculated risks and to be responsible for their actions. In this way, the educator remains on the same side as the student and is never viewed as the problem. The educator remains student-centered. The educator maintains a role of mentor and guide when the student is in times of trouble. The educator remains the educator, armed with resources for teaching and learning and embracing student behavior problems as simply another opportunity to teach.

A Role for School and Classroom Management

Educators need to establish and maintain a healthy school culture. A healthy school culture helps to combat violent and emotion-laden media messages by offering a framework for discussing the dichotomy of modal values that exists between most commercial media messages and the modal values advocated by schools and responsible parents. This is best achieved when educators take a student-centered approach to school discipline and classroom management. It needs to be an approach that gives students a sense of "permanent value" (Dreikurs, 1968).

For example, if the "rules of civility" are broken, the judicious educator needs to take the time to listen to students. Then the educator must act with professional courage, working in the student's best interests to restore relationships and property that may have been damaged by a breach in rules. With this thoughtful, professional approach, the educator is sending a powerful message about the importance of the individual student, all the while mentoring him or her in ways to restore and recover from a problem situation. This kind of judicious discipline is antithetical to the behavior generally displayed in commercial films and television. When modeling such alternative behavior for students, the judicious educator is laying a context, a fabric of neurological connections, which helps prepare their students for ideological change and responsible citizenship in a democratic society. This kind of judicious discipline is the antithesis to coercive, stimulus/response models portrayed on most television shows and in films. It is a "cognitive" paradigm for school discipline. That is, it is a "thinking" approach. For many educators and students it is completely different from current discipline practices in schools, the home, or even discussed in the media. It provides professional educators with opportunities to challenge students' neuronal circuits by offering students "neurological time" and options to consider as alternatives to simple rewards and punishment. It allows us all to transcend the lower levels of moral development and operate at a principled level. Imagine the opportunities for teaching and learning when a student with a problem is met by an educator, who intuitively says, "Tell me about it."

A Role for Education and Legislation -

It has been argued that all human beings physically depend upon optimal biochemical activity in the brain in order to remain healthy and "normal," and that there can be a physical relationship between a biological need for endorphin activity and violent media messages. Reconsider what we know about endorphins and violent media messages.

- We know that endorphins are very powerful peptides that relieve pain and/or induce feelings of pleasure and that they are involved with our emotional well-being and help to provide intrinsic rewards.

- We know that endorphins can be released in the brain as a result of viewing and listening to media messages that are perceived as exciting, emotion laden and/or stressful.

- We know that the binding of endorphins to opiate receptors is physically addicting.

Also, it has been argued that:

- Too much endorphin activity can result in *desensitization*.
- Too little endorphin activity can cause anxiety and depression.
- Endorphin "thrills" can help to assist the transfer of imagined behavior to real-world action.
- The physical need for endorphin activity in the brain can motivate an individual to seek endorphin activating experience, whether real or imagined.

If any or all of these propositions are possible or probable, we should probably develop a culture that adjudicates violent and emotion-laden media messages with the same respect we attribute legalized drugs, like alcohol and tobacco products. We should advocate use and consumption of media messages in moderation; and we need to work to inform the population about the social, cultural, and personal implications that exposure to violent and emotion-laden media messages have on us as individuals and as a society. We need to inform the population by explaining in no uncertain terms the impact violent and emotion-laden media messages can have on our quality of life. This will be a role for media education.

In addition, media-makers need to be held accountable for the quality of messages our population consumes. This will be a role for media legislation. Together, education and legislation must work to foster maximum potential for the media and their messages and, at the same time, minimize their adverse effects on the individual and society. Only by working together in education and legislation can we ensure that the media messages we produce and consume are quality products and will lead to a richer human existence.

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